Claims

1. An inhaler for the delivery of a dose of powdered medicament for inhalation by a user comprising a housing containing a cylinder and a piston together defining a chamber, the piston and cylinder being slideable relative to each other during a compression stroke in response to the application of a load thereto by the user to generate a charge of compressed air in the chamber for entraining a dose when the charge is released, the inhaler including means for increasing the mechanical advantage during a compression stroke so that the effort applied by the user remains substantially constant throughout the compression stroke irrespective of the increase in pressure in the chamber.

2. An inhaler according to claim 1, wherein the effort applied by the user during the compression stroke is a torque operable to rotate the piston and said means is configured so that the linear distance travelled by the piston per angle through which it rotates during the compression stroke reduces to increase the mechanical advantage.

3. An inhaler for the delivery of a dose of powdered medicament for inhalation by a user comprising a housing containing a cylinder and a piston together defining a chamber, the piston being movable relative to the cylinder to enable a user to generate a charge of compressed air in the chamber to entrain a dose when the charge is released, wherein the cylinder and the piston include means thereon operable to compress a charge of air in the chamber in response to rotation of the piston relative to the cylinder.

4. An inhaler according to claim 2 or claim 3, wherein the means comprises a cam track and a pin located in the cam track so as to slide freely therein during rotation of the piston.

5. An inhaler according to claim 4, wherein the cam track is formed in the piston and the pin is mounted so as to extend radially into cylinder and locate in the cam track.

6. An inhaler according to claim 4 or claim 5, wherein at least a portion of the cam track follows a helical path that extends along the axis around the outside of the piston.

7. An inhaler according to claim 6, wherein the ends of the helical portion of the cam track are joined by a second straight portion of cam track extending parallel to the axis of the cylinder so that the cam track forms a complete circuit for the pin during movement of the piston into and out of the cylinder.

8. An inhaler according to claim 7, wherein the helical portion of the cam track extends substantially 360 degrees around the piston.

9. An inhaler according to claim 7 or claim 8, wherein the cam track includes a region between the helical portion and the straight portion having a pitch that is substantially zero degrees relative to a plane perpendicular to the axis of the cylinder.

10. An inhaler according to claim 9, wherein the pin locates in said region when the piston is in a home position in which the piston is fully retracted into the cylinder.

11. An inhaler according to claim 10, wherein the cam track includes a detent therein intermediate the ends of said region configured so that the pin and the detent co-operate with each other during initial rotation of the piston so that additional torque must be applied to the piston by the user to force the pin past the detent and so rotate the piston out of its home position.

12. An inhaler according to any of claims 9 to 11, wherein the helical portion of the cam track includes another region intermediate its ends having a pitch that is substantially zero degrees relative to a plane perpendicular to the axis of the cylinder.

13. An inhaler according to any of claims 10 to 12, including an interlock mechanism to prevent rotation of the piston out of said home position prior to movement of the interlock mechanism.

14. An inhaler according to claim 13, wherein the interlock mechanism comprises a slide member on the housing movable into and out of engagement with the piston when the piston is in its home position.

15. An inhaler according to claim 12, including a mouthpiece and a cap pivotable between an open position for inhalation through the mouthpiece and a closed position in which the mouthpiece is covered by the cap, wherein movement of the slider is prevented when the cap is in the closed position.

16. An inhaler according to any of claims 4 to 15, when dependent on claim 3, wherein the helical portion of the cam-track has a constant pitch angle.

17. An inhaler according to any of claims 4 to 15, when dependent on claim 2, wherein the helical portion of the cam track has a pitch angle that varies along the length of the piston so that the linear distance travelled by the piston reduces relative to the angle through which it rotates during the compression stroke to increase the mechanical advantage.

18. An inhaler according to any preceding claim wherein the piston comprises a body portion and a handle portion, the cam track being formed at an interface between the body portion and the handle portion.

19. An inhaler according to claim 18, wherein the body portion comprises a stem part and a head part of larger diameter than the stem part, a part helically shaped shoulder being formed at the interface between the head part and the stem part.

20. An inhaler according to claim 19, wherein the handle portion comprises a cylindrical body to receive the stem part of the body portion, an end face of the handle portion in which the stem part is received being part helical in shape to correspond to the part helically shaped shoulder of the body portion.

21. An inhaler according to any of claims 18 to 20, wherein the body portion and the handle portion include co-operating means that engage to fit the stem part in the cylindrical body in only one orientation.

22. An inhaler according to claim 21, wherein the co-operating means comprises a radially inwardly depending lug on the handle portion that locates in a rebate formed in the surface of the stem part of the body portion.

23. An inhaler according to claim 22, wherein the base of the stem engages with a surface of the handle to prevent further insertion of the stem part into the handle portion, the opposing part helically shaped shoulder and part helically shaped end face being spaced from each other to form the sidewalls of the cam track.

24. An inhaler according to any preceding claim comprising a valve module including a valve body and a rotary valve plate rotatably mounted on the body, the piston and the rotary valve plate including co-operating means that engage as the piston is rotated into the cylinder so that the rotary valve plate rotates together with the piston relative to the valve body.

25. An inhaler according to claim 24, wherein the valve body includes a main diaphragm valve port and a pilot reservoir port, the rotary valve plate being configured to open and close said ports as the rotary valve plate rotates.

26. An inhaler according to claim 25, wherein the rotary valve plate has first and second apertures therein that align with the main diaphragm valve port and the pilot reservoir port respectively, as the rotary valve plate rotates, to open said ports.

27. An inhaler according to claim 26, wherein the apertures in the rotary valve plate are configured such that the pilot reservoir port is opened prior to opening of the main diaphragm port.

28. An inhaler according to claim 26 or 27, wherein the apertures in the rotary valve plate are configured such that the pilot reservoir port is closed prior to closing of the main diaphragm port.

29. An inhaler according to any of claims 24 to 28, wherein the rotary valve plate is configured to prevent the release of a charge of compressed gas from the chamber until the chamber is substantially fully primed.

30. An inhaler according to claim 29, wherein the charge of compressed gas is exhausted through the main diaphragm port when the charge is released.

31. An inhaler according to any of claims, wherein the co-operating means engage for approximately the last 180 degrees of rotation of the piston into the cylinder so that the rotary valve plate rotates relative to the valve module through 180 degrees.

32. An inhaler according to claim 31, wherein the rotary valve plate has a second set of first and second apertures provided therein.

33. A method of operating an inhaler for the delivery of a dose of powdered medicament for inhalation by a user comprising a housing containing a cylinder defining a chamber and a piston movably received in the cylinder, the method including the step of withdrawing the piston from the cylinder and rotating the piston to draw it back into the cylinder to generate a charge of compressed air in the chamber.

34. A method of operating an inhaler according to claim 33, wherein the method includes the step of withdrawing the piston from the cylinder by applying an axial force thereto.

35. A method of operating an inhaler according to claim 33 or claim 34, the inhaler including a cap which covers a mouthpiece in a closed position and a slide member on the housing movable into and out of engagement with the piston when the piston is fully received in the cylinder, the method including the step of opening the cap and moving the slider to disengage the piston before withdrawing the piston from the cylinder.

36. An inhaler substantially as hereinbefore described with reference to the accompanying drawings.

37. A method of operating an inhaler substantially as hereinbefore described.